



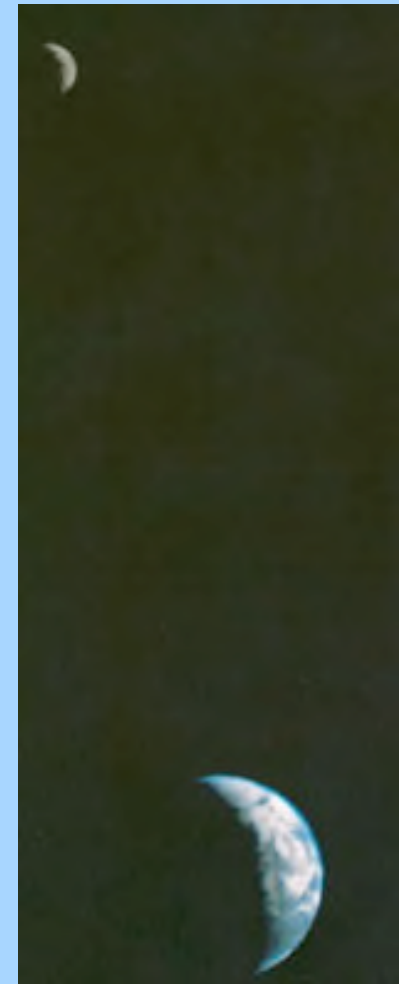
NASA Vision & Mission

NASA vision for the future is:!

- ! Build!
- ! Educate!
- ! Innovate!

The NASA mission is:!

- ! To understand and protect Earth!
- ! To explore the Universe!
- ! To inspire the next generation!
- ! as only NASA can!





Gliding Experiments of the Wright Brothers

The Wrights and Flight Research

1899-1908

Al Bowers

Jennifer Hansen Cole

Cam Martin

NASA Dryden Flight Research Center

Background: The Times

Transcontinental Railroad...



- ! the great engineering achievement of the time!
- ! understanding of “two-track” vehicle systems (buggys, carts, & trains)!
- ! completed on 10 May 1869 (Wilbur was two years old)!

Background: Progenitors

- ! Otto Lilienthal"
 - experiments from 1891 to 1896!
- ! Samuel P Langley"
 - experiments from 1891-1903!
- ! Octave Chanute"
 - experiments from 1896-1903!

Otto Lilienthal

- ! Glider experiments 1891 - 1896!



Dr Samuel Pierpont Langley

- ! Aerodrome experiments 1887-1903!



Octave Chanute

- ! Gliding experiments 1896 to 1903!



A Hundred Years
Ago...

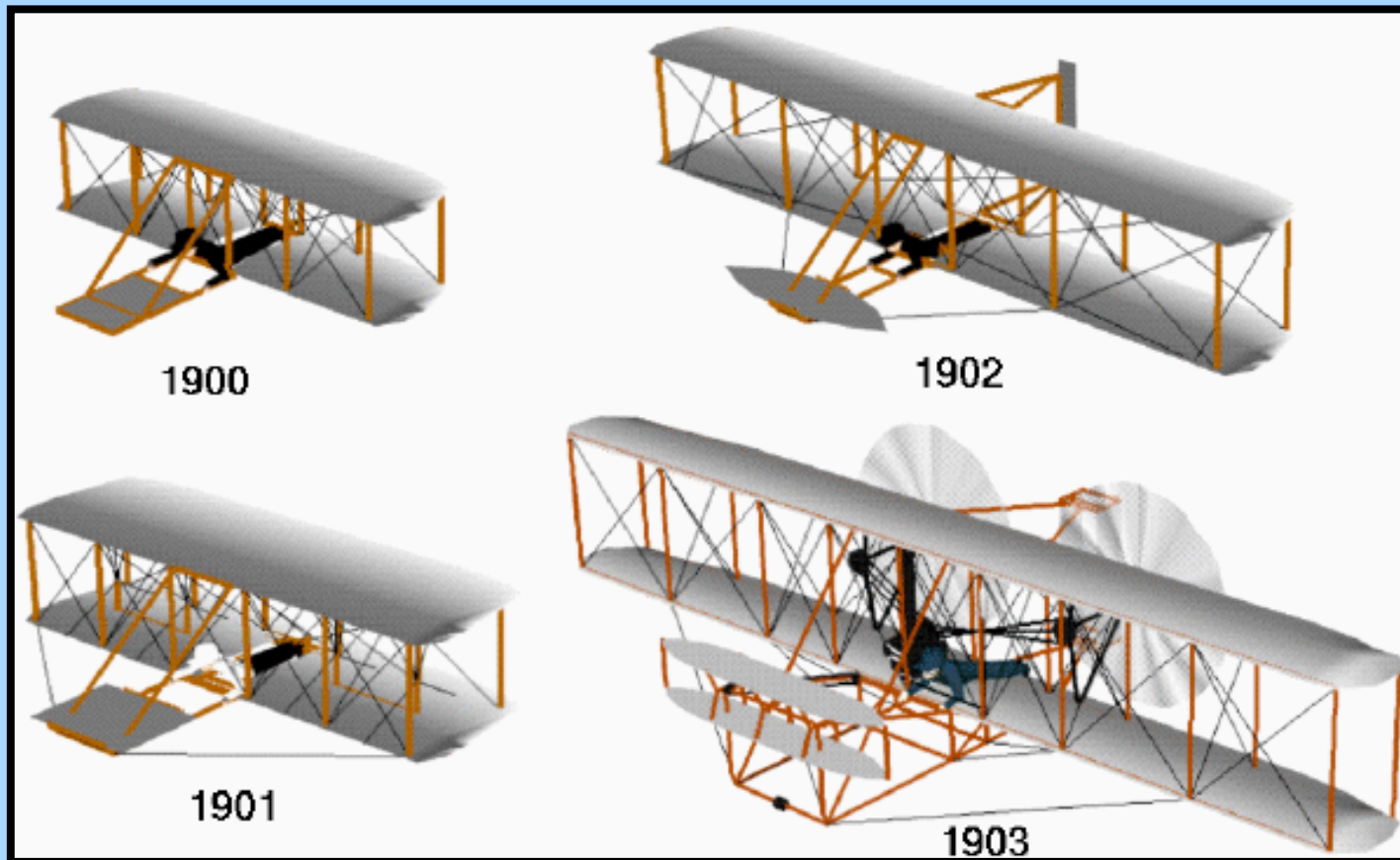
1911 Wright Glider



24 Oct 1911

Kitty Hawk Flight Research

1900-1903



Wilbur and Orville



16 Apr 1867 – 30 May 1912

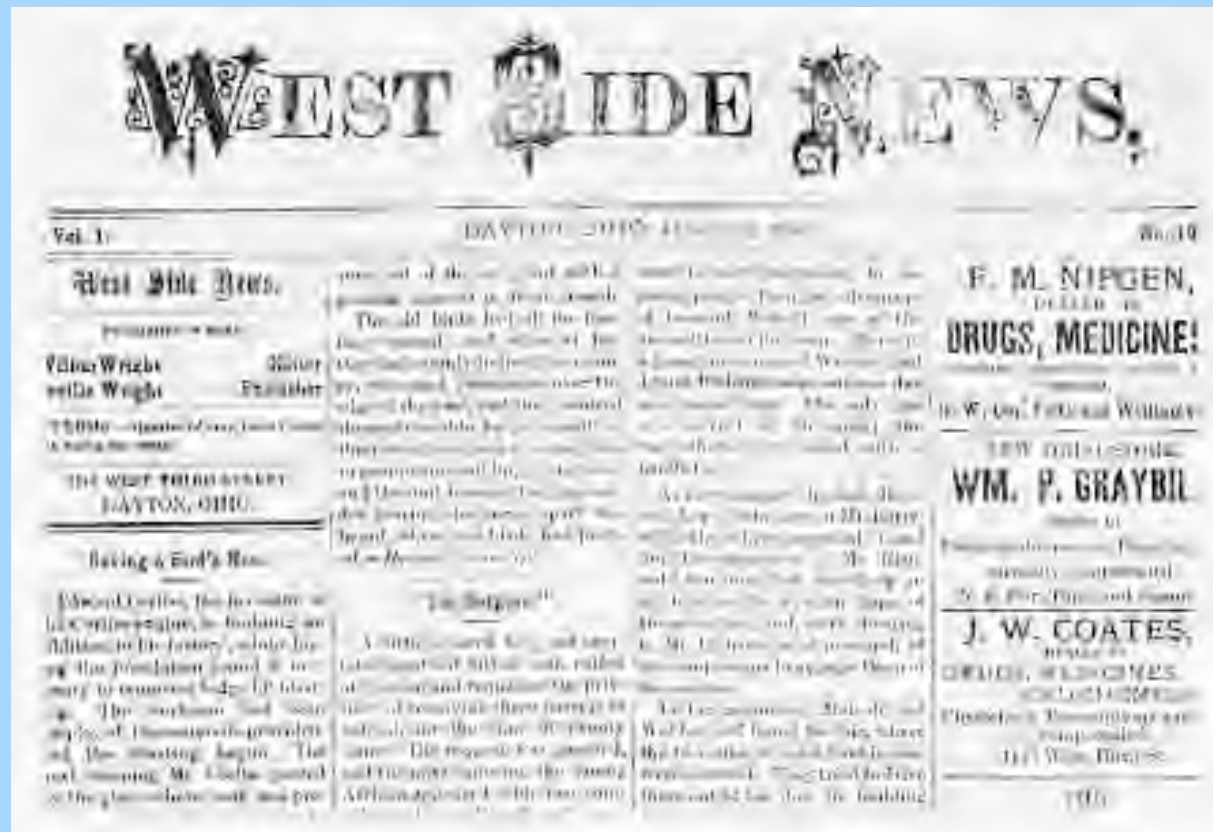


19 Aug 1871 – 30 Jan 1948

Wright Brothers Timeline

- 1878 The Wrights receive a gift of a toy helicopter
- 1895 The Wrights begin to manufacture their own bicycles
- 1896 The Wrights take an interest in the "flying problem"
- 1899 Wilbur devises a revolutionary control system, builds a kite to test it; also writes the Smithsonian.
- 1900 The Wright brothers fly a glider at Kitty Hawk, NC
- 1901 The Wrights fly a bigger glider at Kitty Hawk, NC
- 1901 In Dayton, OH, they build a research wind tunnel
- 1902 The Wrights perfect their glider and learn to fly
- 1903 The Wright brothers make the first controlled, sustained powered flight at Kitty Hawk.
- 1905 In Dayton, the Wrights develop a practical airplane

Wright Brothers' Paper



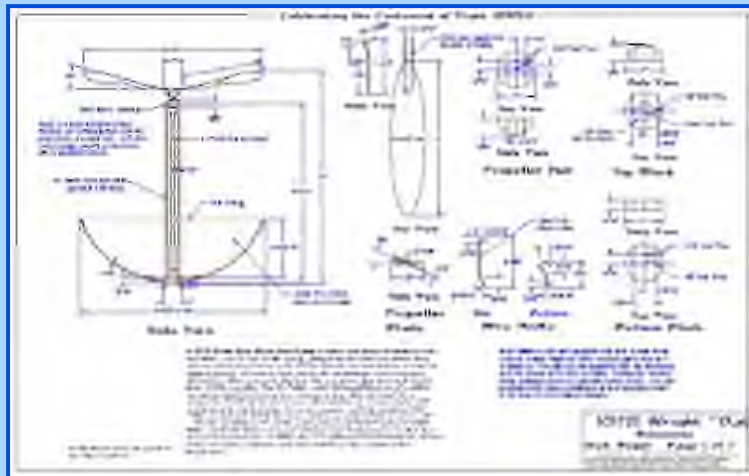
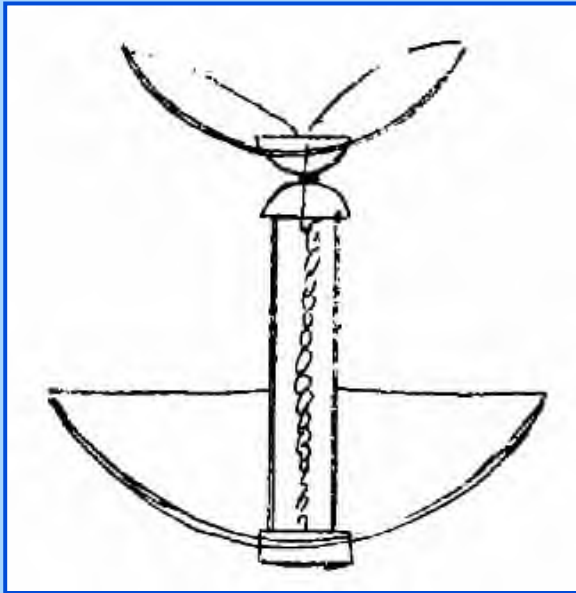
Dayton's "West Side News"!

Wright Brothers' Cycle Company

- ! “single-track” vehicle mechanics!



Inspiration: 1878

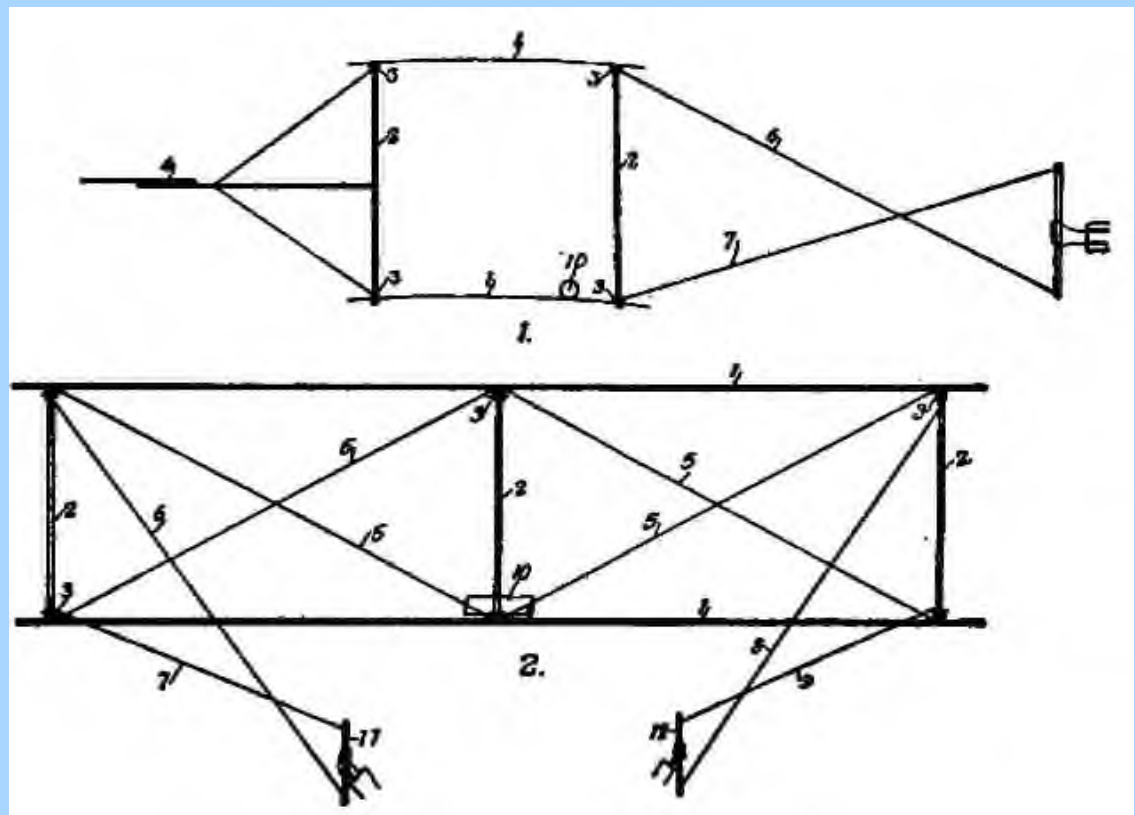


Inspiration: July 1899



1899 Kite Experiments

Dayton Ohio



1900 Wright Glider

- ! Span: 17 feet!
- ! Chord: 5 feet!
- ! Gap: 4 feet, 8 inches!
- ! Camber: $1/23$!
- ! Wing Area: 165 sq ft!
- ! Weight with operator
190 lb!



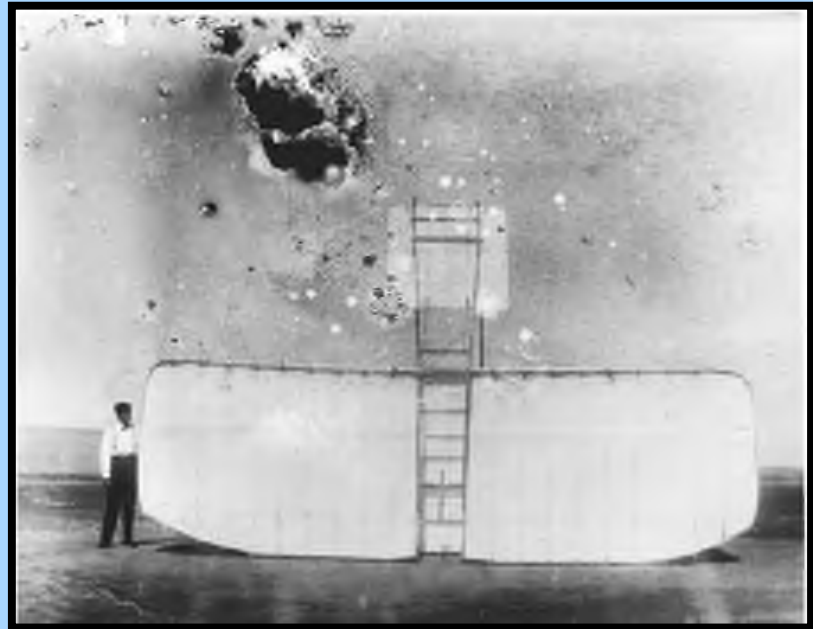
1900 Wright Glider

Kitty Hawk September - October 1900



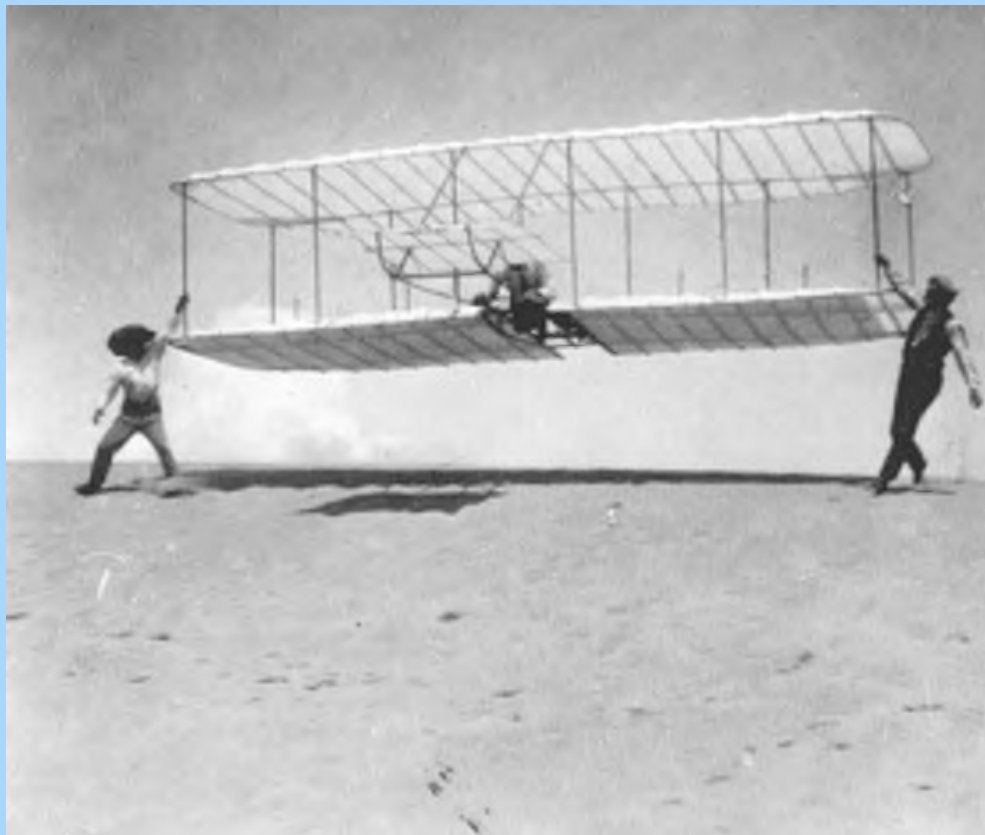
1901 Wright Glider

- ! Span: 22 feet!
- ! Chord: 7 feet!
- ! Gap: 4 feet, 8 inches!
- ! Camber: $1/17$!
- ! Wing Area: 290 sq ft!
- ! Horizontal Rudder Area
18 sq ft!
- ! Length 14 feet!
- ! Weight 98 lb!

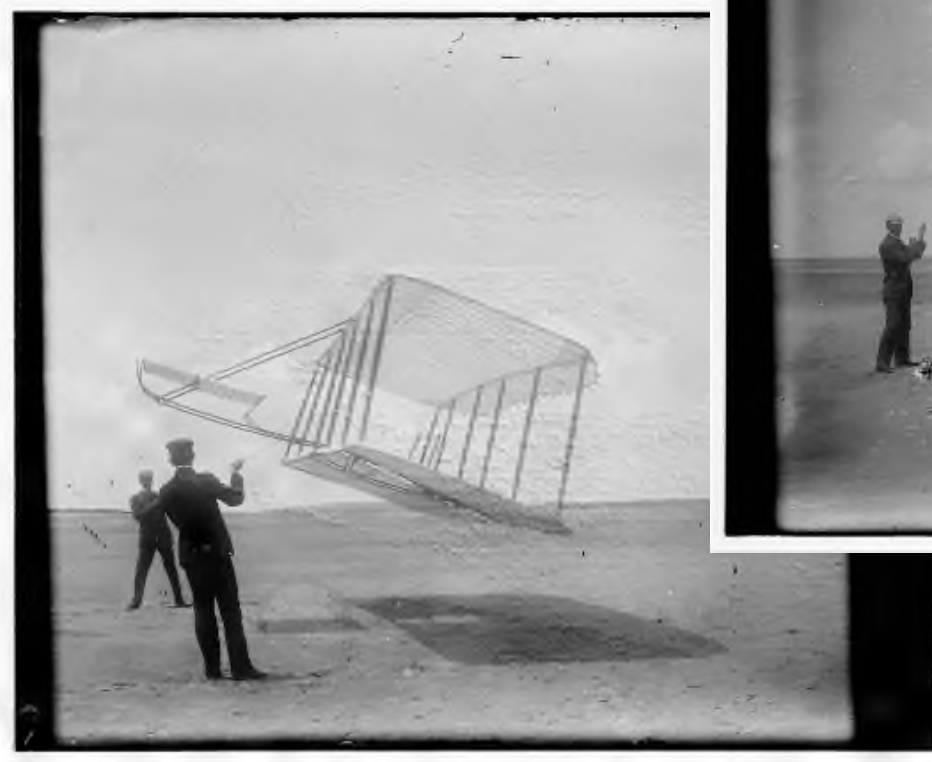


1901 Wright Glider

Kitty Hawk July - August 1901



1901 Glider Flown as a Kite



1901 Wright Flown as Glider



Kitty Hawk 1901



They go home, very discouraged.

**On the train back to Dayton,
Wilbur tells Orville that men would
not fly for another fifty years..!**

Dayton Experiments

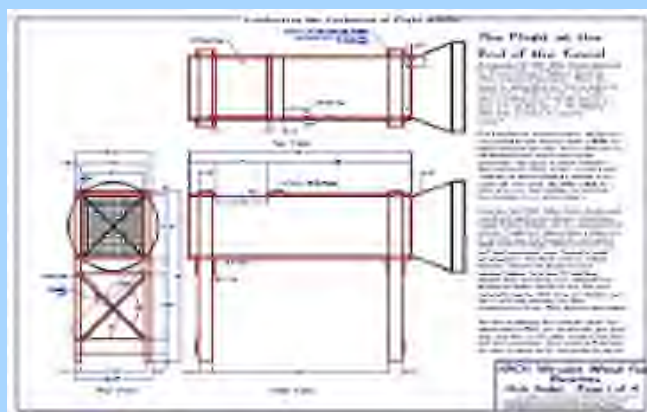
October 1901



1901 Wind Tunnel

16 inch square section x 6 feet





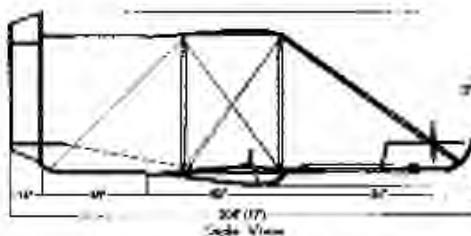
1901 Wright Wind Tunnel Results



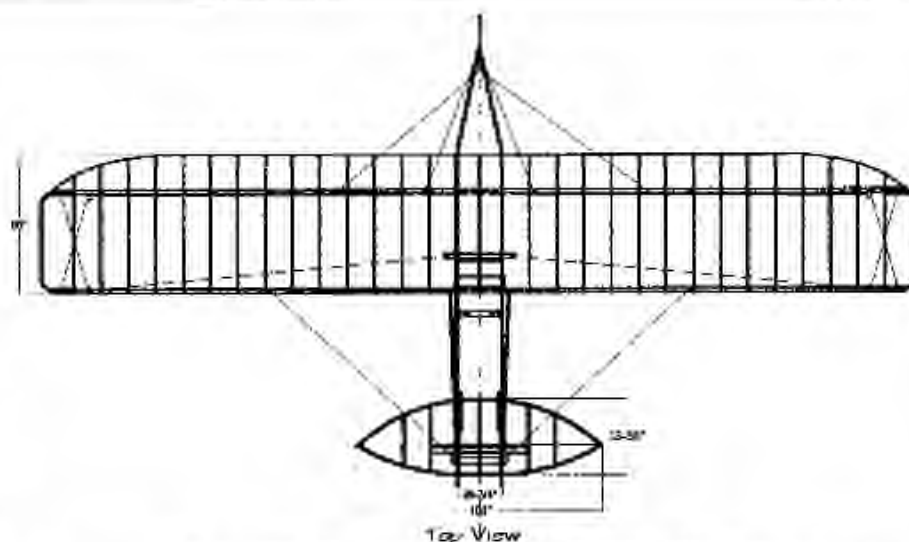
1902 Wright Glider

Specifications

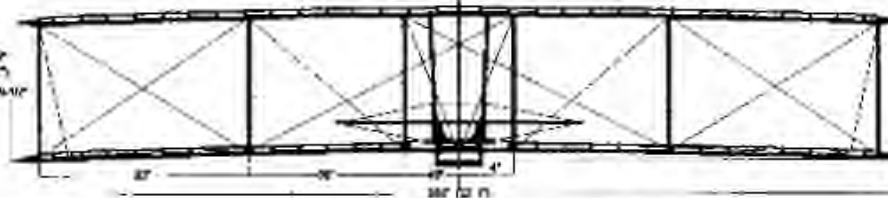
Wingspan: 32 feet, 1 inch
 Chord: 5 feet
 Camber: 1/20 to 1/24
 Anhedral: 4 inches
 Wing Area: 305 square feet
 Elevator Area: 15 square feet
 Rudder area: 5.7 square feet
 Overall Length: 17 feet
 Overall Height: 8 feet, 3 inches
 Gap between wings: 5 feet
 Weight: 112 pounds
 Number of flights: Approximately 2000
 Longest distance flown: 622 feet
 Longest time in flight: 1 minute, 12 seconds
 Frame materials: Spruce, ash, waxed linen cord
 Hardware: Mild steel, boxwood (for pulleys)
 Rigging: 15-gauge steel wire
 Wing covering: Cotton muslin, 209 thread count



Side View



Top View



Front View

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1902 Wright Glider

Reproduction

Nick Engler Page 1 of 20

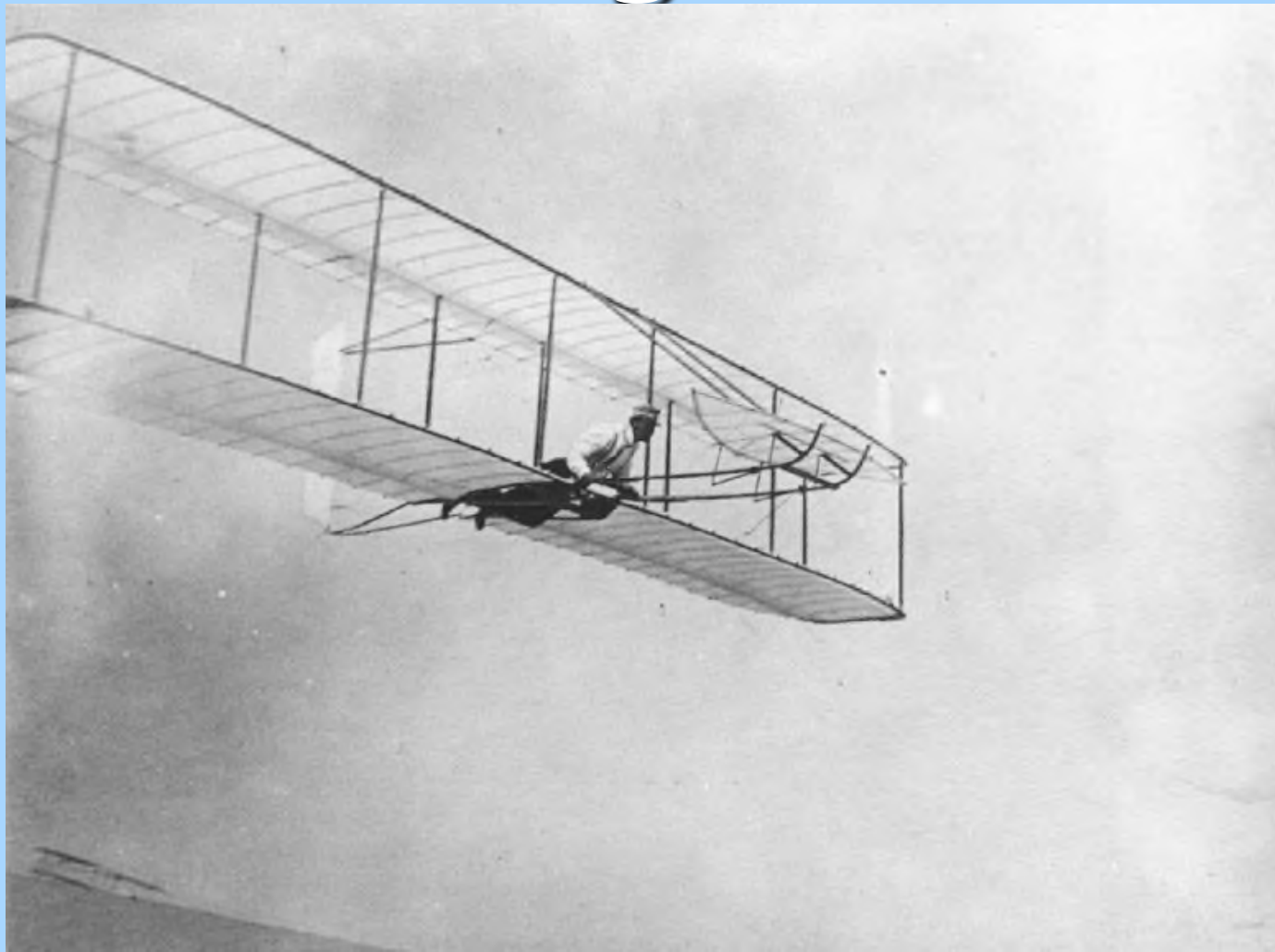
Copyright 1992 Wright Brothers Association, Inc.
 P.O. Box 284, West Milton, OH 45381
 www.wrightbrothers.org

1902 Wright Glider

- ! Span: 32 feet 1 inch!
- ! Chord: 5 feet!
- ! Gap: 4 feet, 7 inches!
- ! Camber $\frac{1}{24}$!
- ! Wing Area: 305 sq ft!
- ! Horizontal Rudder Area 15 sq ft!
- ! Length 16 feet 1 inch!
- ! Weight 112 lb!
- ! Three configurations!



1902 Wright Glider

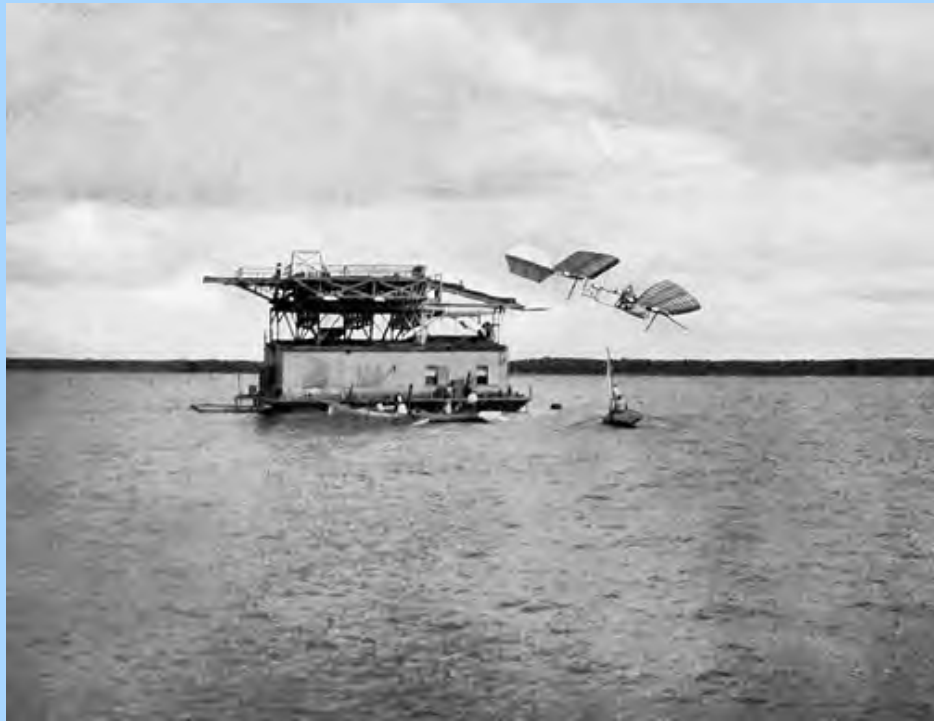


Centennial of Controlled Flight

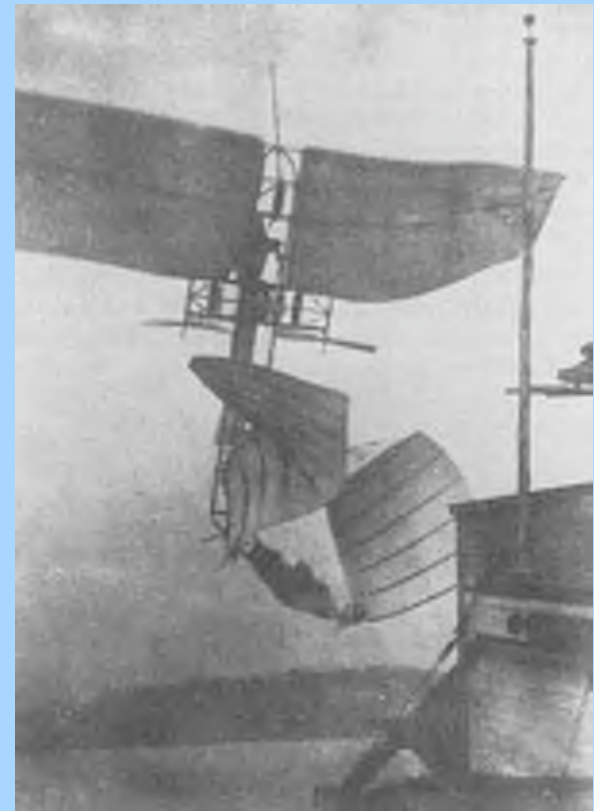
24 October 1902



1903 Langley Aerodrome

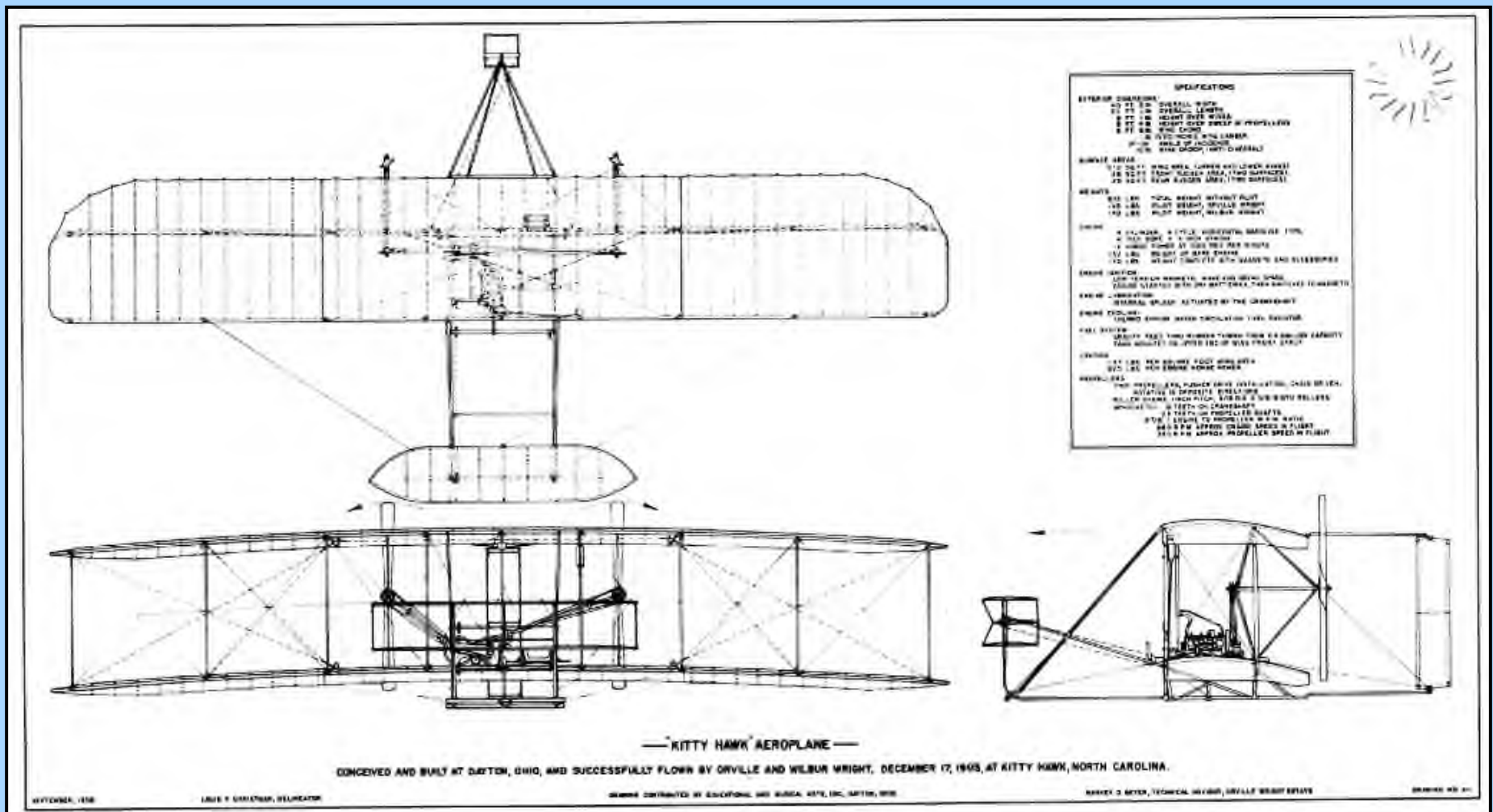


Oct 7, 1903



Dec 8, 1903

1903 Wright Flyer



1903 Wright Flyer

- ! Span: 40 feet 4 inch!
- ! Chord: 6 feet 6 inches!
- ! Gap: 6 feet 2 inches!
- ! Camber $\frac{1}{20}$!
- ! Wing Area: 510 sq ft!
- ! Horizontal Rudder Area 48 sq ft!
- ! Vertical Rudder 21 sq ft!
- ! Length 21 feet 1 inch!
- ! Weight 605 lb!



1903 Wright Flyer

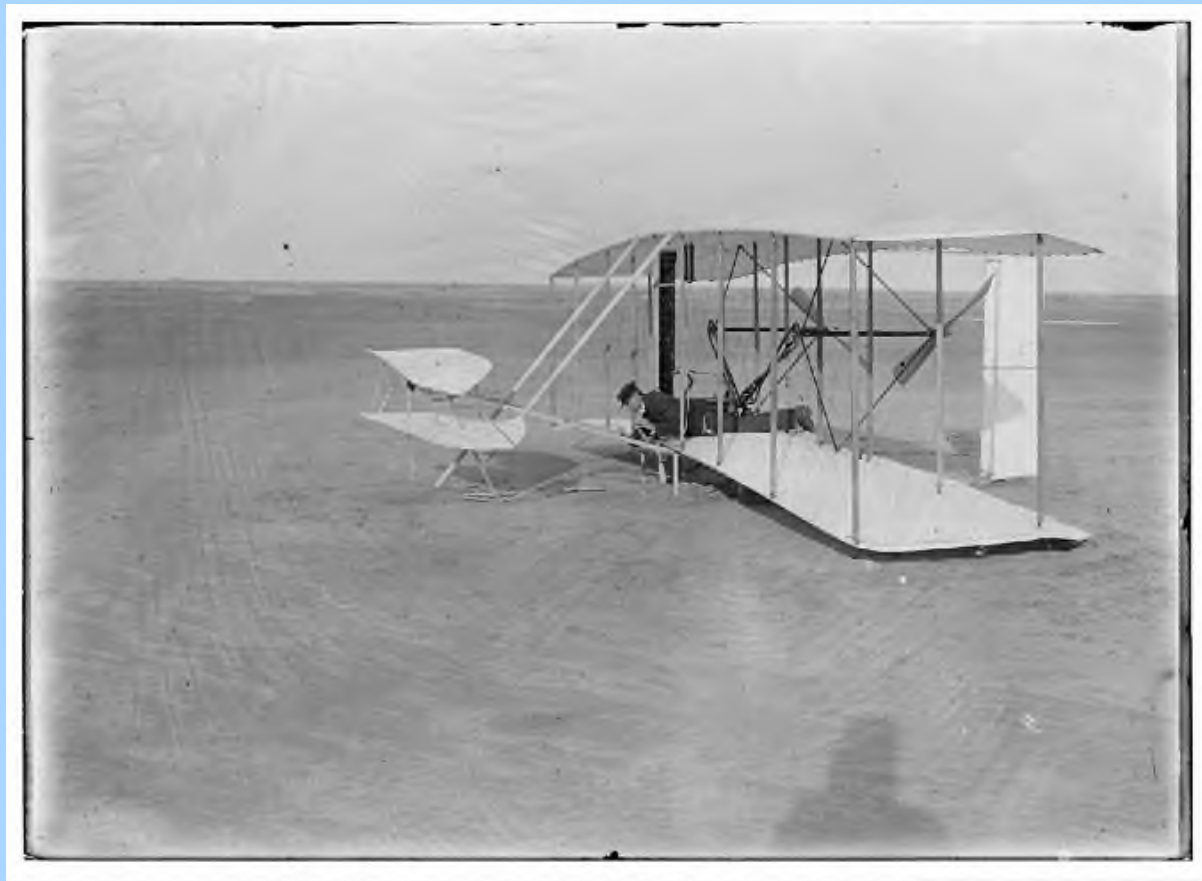
December 14, 1903



Wilbur wins the coin toss, and...

1903 Wright Flyer

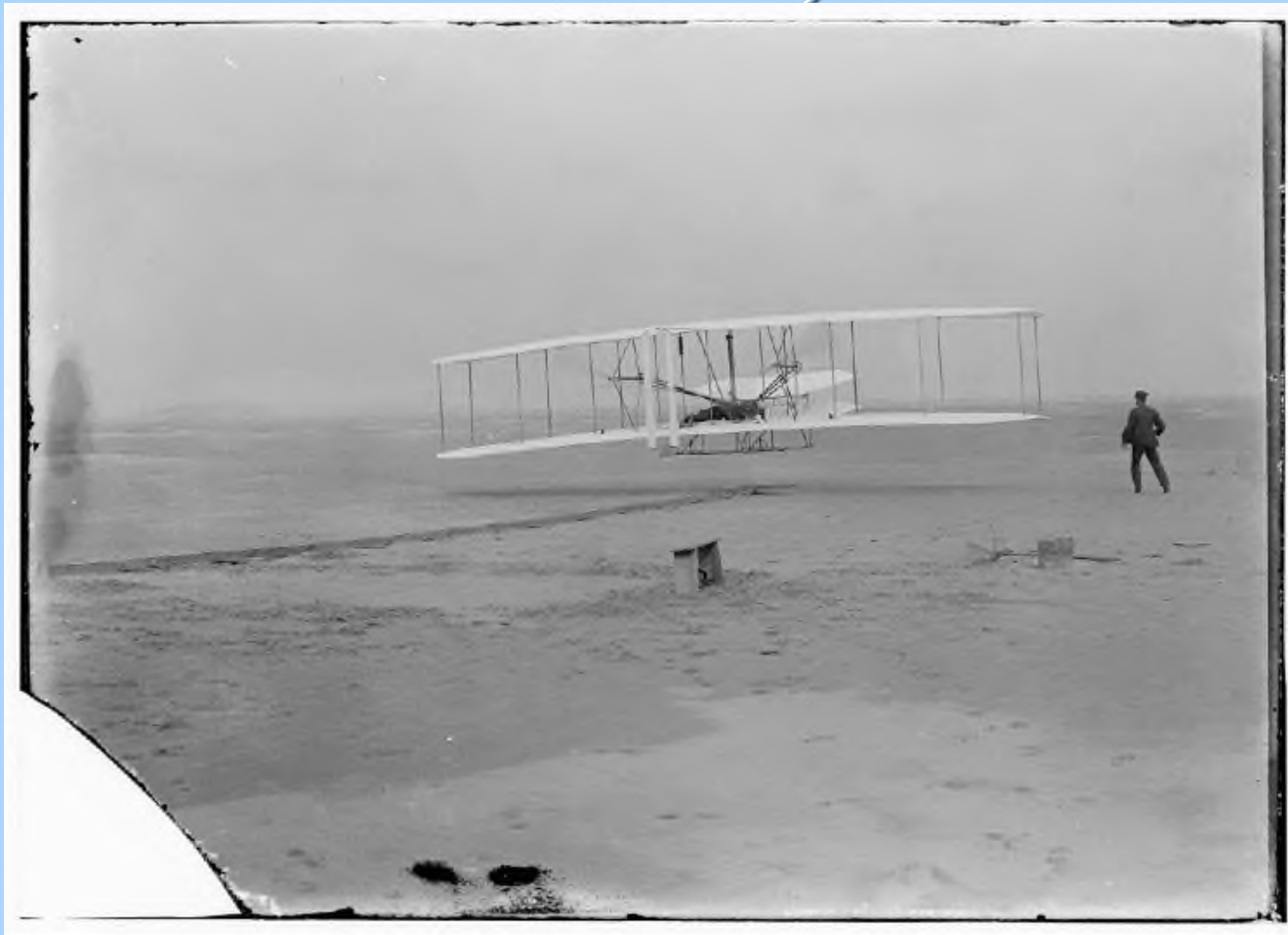
December 14, 1903



Oops!

1903 Wright Flyer

December 17, 1903



1903 Wright Flyer



They tell the world...

Form No. 100.

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INCORPORATED
23,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD.

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This is an UNREPLATED MESSAGE, and is delivered by request of the sender, under the conditions named above.

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176 0 KA 08 35 Paid. Via Norfolk Va

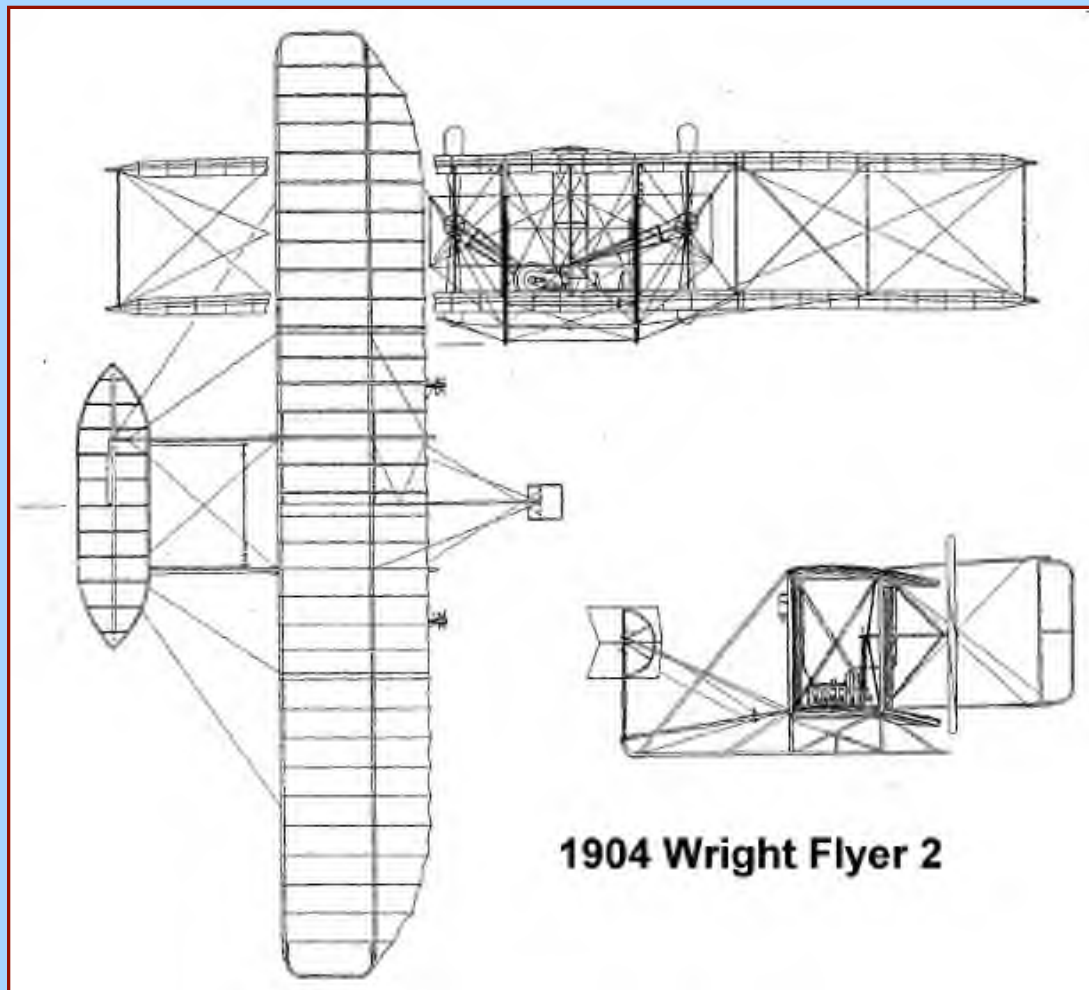
Kitty Hawk N C Reg 17

Bishop W Wright

7 Hawthorne St

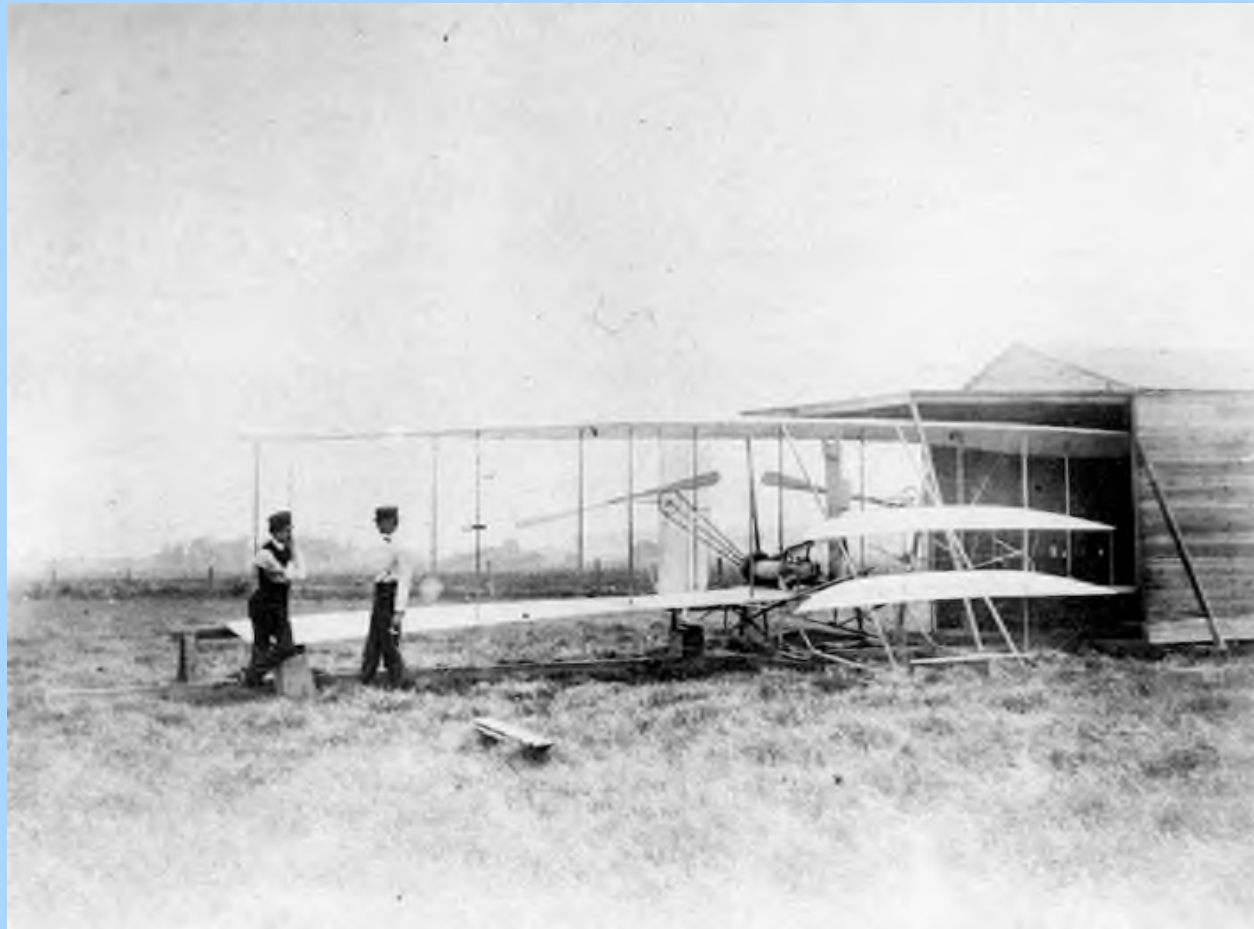
Success four flights Thursday morning all against twenty one mile
wind started from Level with engine power alone average speed
through air thirty one miles longest 37 seconds inform Press
home ~~night~~ Christmas . Orville Wright 525P

1904 Wright Flyer



1904 Huffman Prairie Ohio

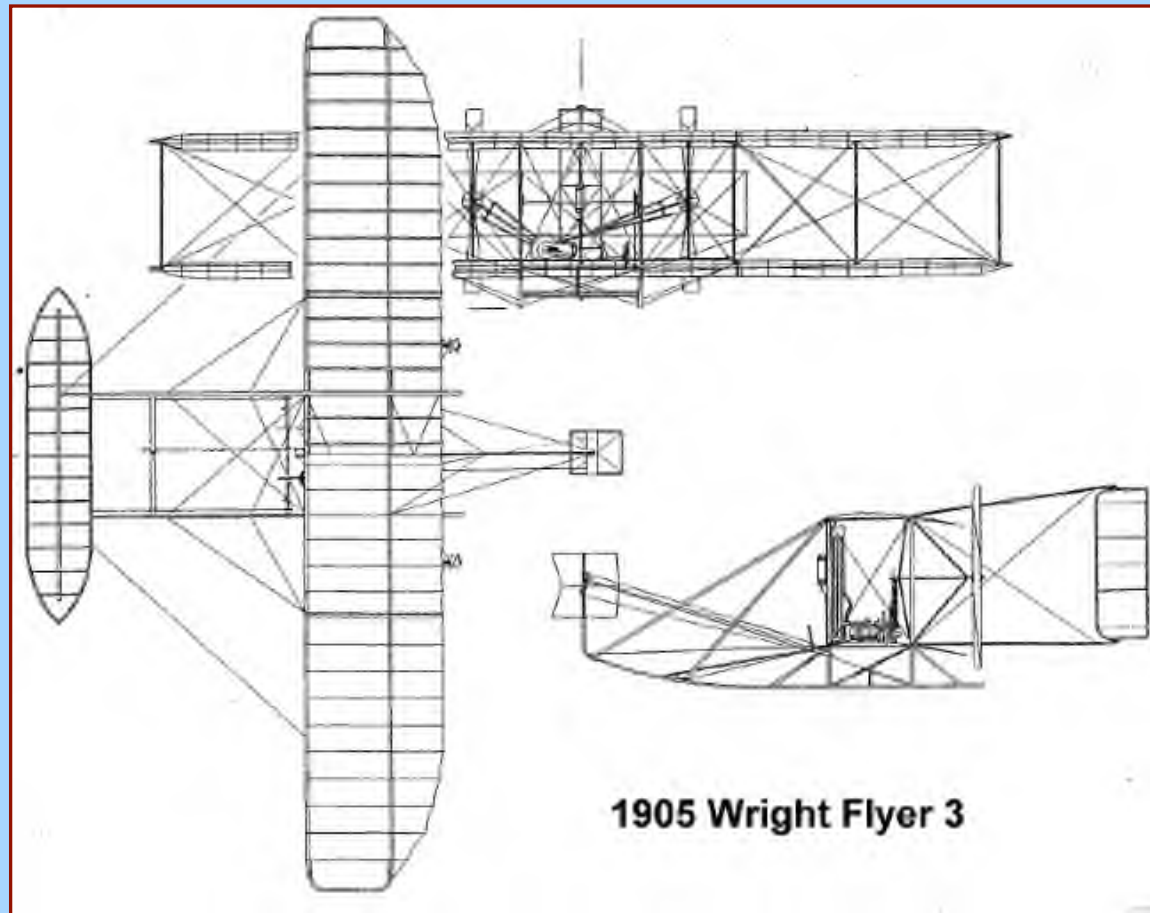
September 20, 1904 First Complete Circle in an Airplane



1904 Wright Flyer II



1905 Wright Flyer



1905 Huffman Prairie OH

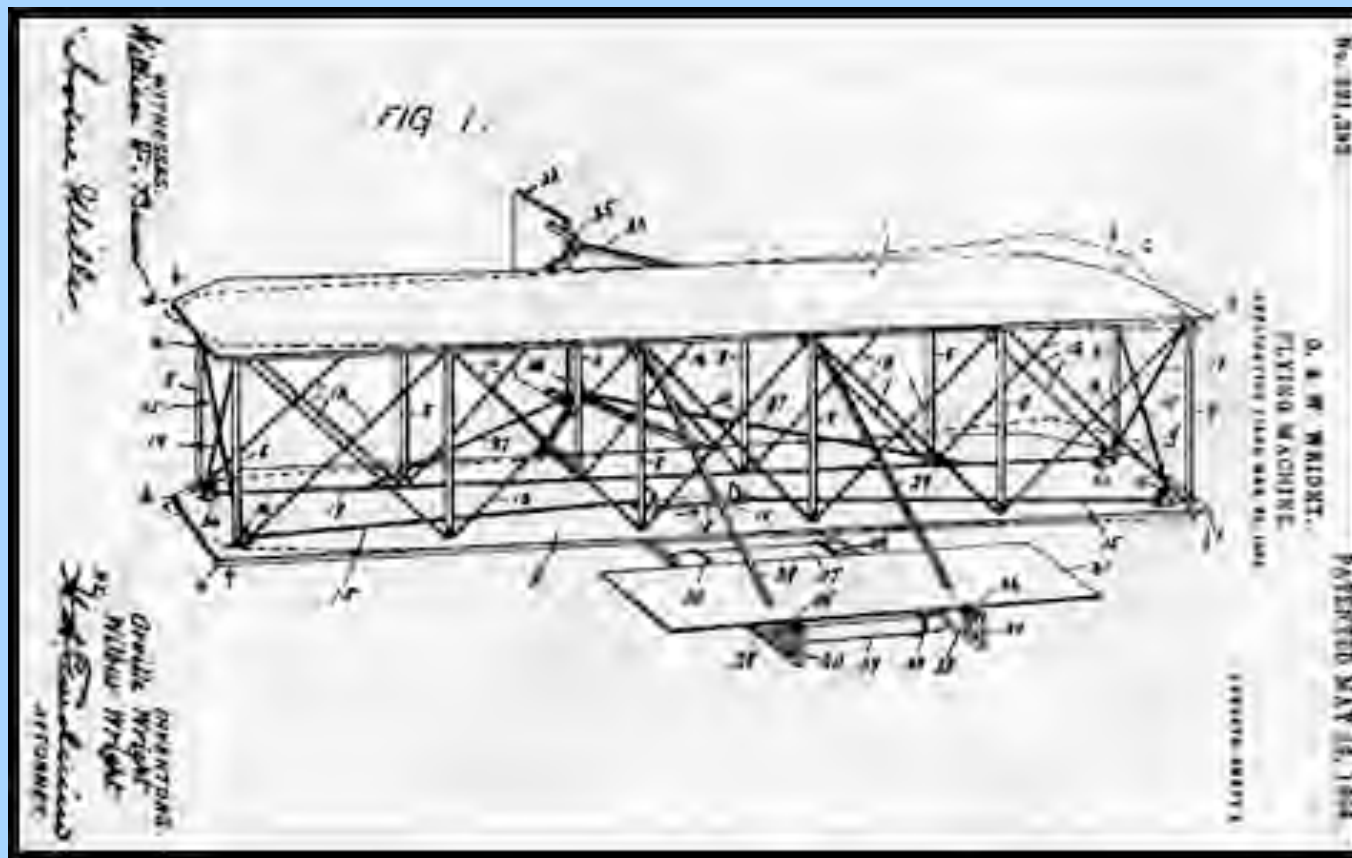
Oct 4, 1905 Extended Flight in an Airplane (38 minutes)



Wright Flying Machine Patent

#821,393

May 22, 1906



1908-1909 France & Virginia

Public trials of the first practical airplane



1909 Clarke-Wright Glider

- ! Built as a trainer to Wright specs!



1911 Wright Glider

- ! Built for autopilot experiments!
- ! Set duration record (9 min 45 sec)!



The Rest is History...

- ! 1904 Flights of 5+ minutes duration!
- ! 1905 Flights to 38 minutes duration !
- ! 1906 - 1907 Commercialization!
- ! 1908 - 1909 Flight Demonstrations!
 - ! Wilbur in France, Italy and Germany !
 - ! Orville in United States!
- ! 1909 The Wright Company is established!
 - ! Clarke-Wright glider in England!
 - ! Established Flying School in Alabama, OH!
- ! 1911 Glider Experiments with autopilot!
- ! Orville serves on NACA board from 1920 to 1948!



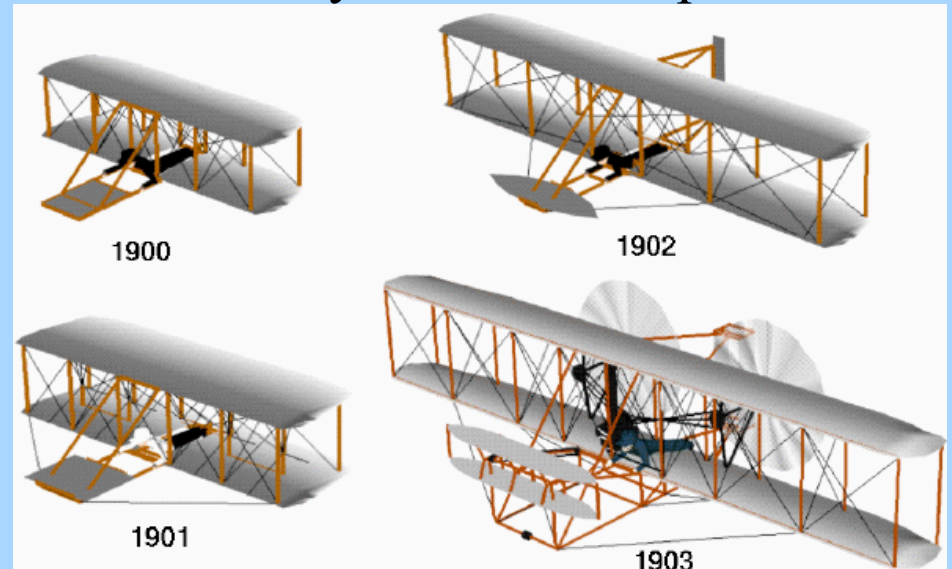
NACA Board, 1938

What Does Flight Research Accomplish?

- Separates the Real from the Imagined
- Uncovers the Unexpected and the Overlooked
- Forces the Realistic Integration of the Pilot
- Forces the Development of Reliable Prediction and Test Processes
- Requires Every Problem to Be Addressed
- Promotes Technology Transfer
- Builds a Core Technical Team

Flight Research Lessons Learned Then...Still Apply Today

- ! Make sure you really understand the problem
- ! Do a literature search and read and talk
- ! Plan carefully...and record as much as possible
- ! Identify and measure your most important parameters
- ! Plan for the unexpected...and expect differences
- ! Test over a large envelope but not necessarily a full envelope
- Fly early, as much as possible
 - more visibility
 - more attention to “Real” problems
 - much more credibility
 - faster technology transfer
- *Get a simulation going ASAP*



Understanding the Wright's Accomplishments Through Evaluation



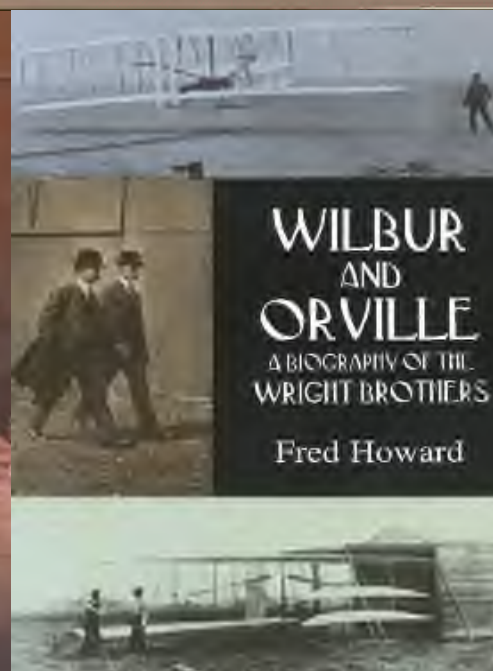
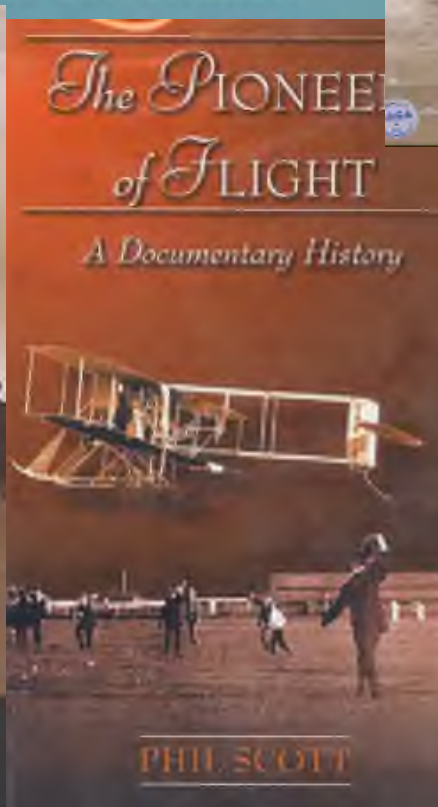
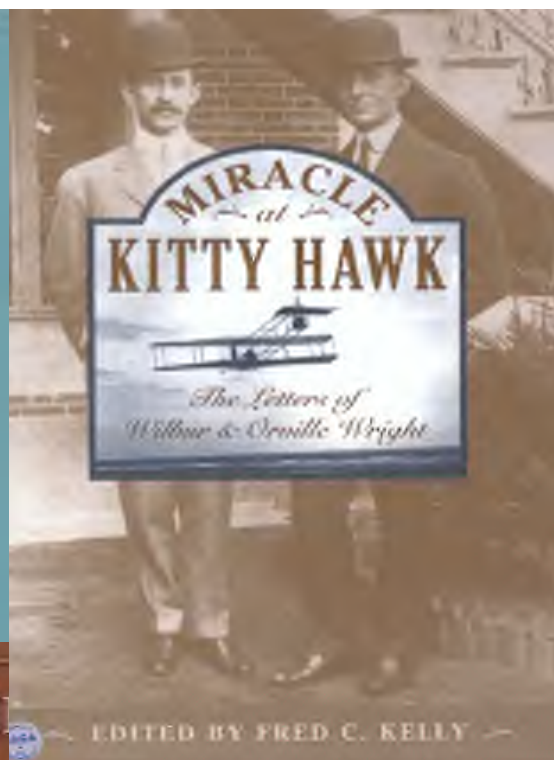
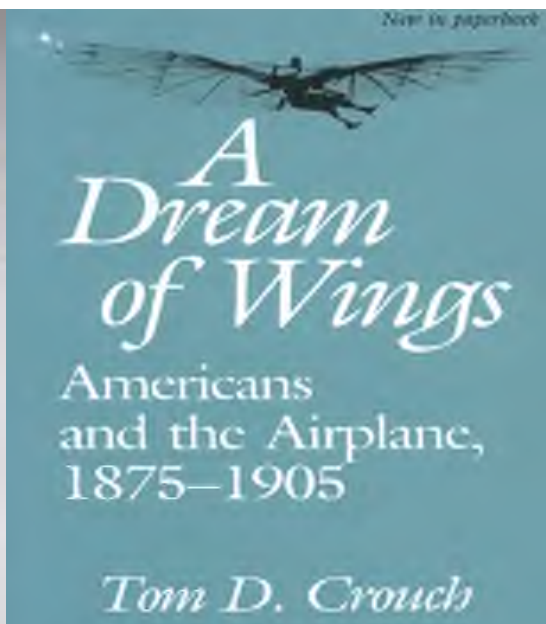
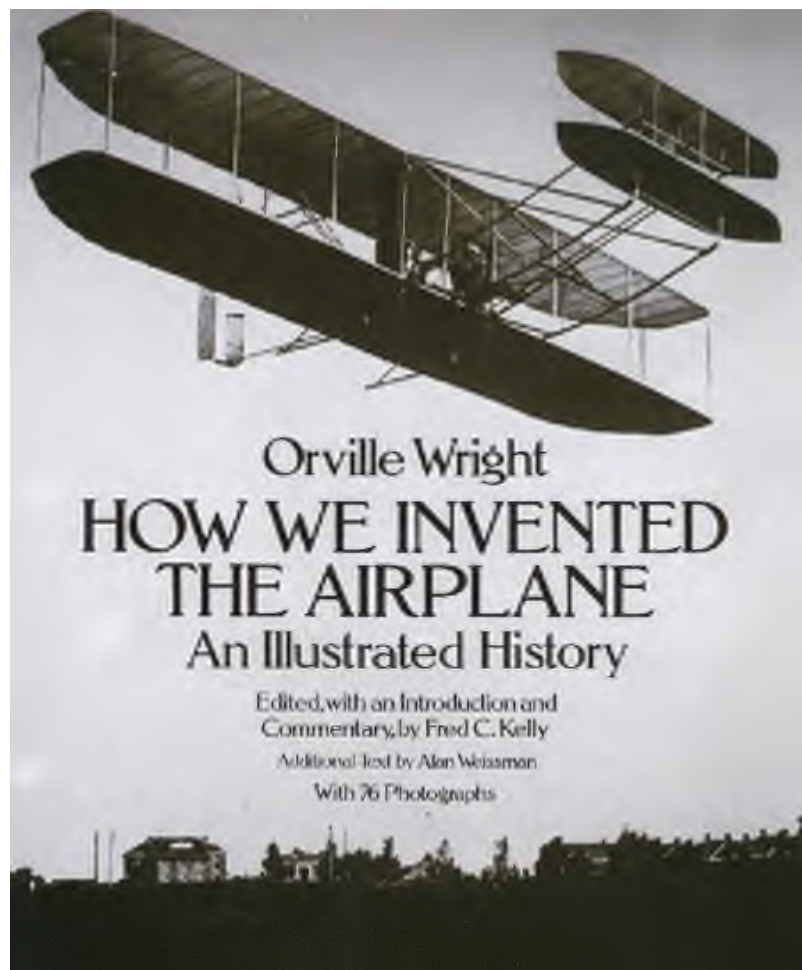
Wright Flyers Today!

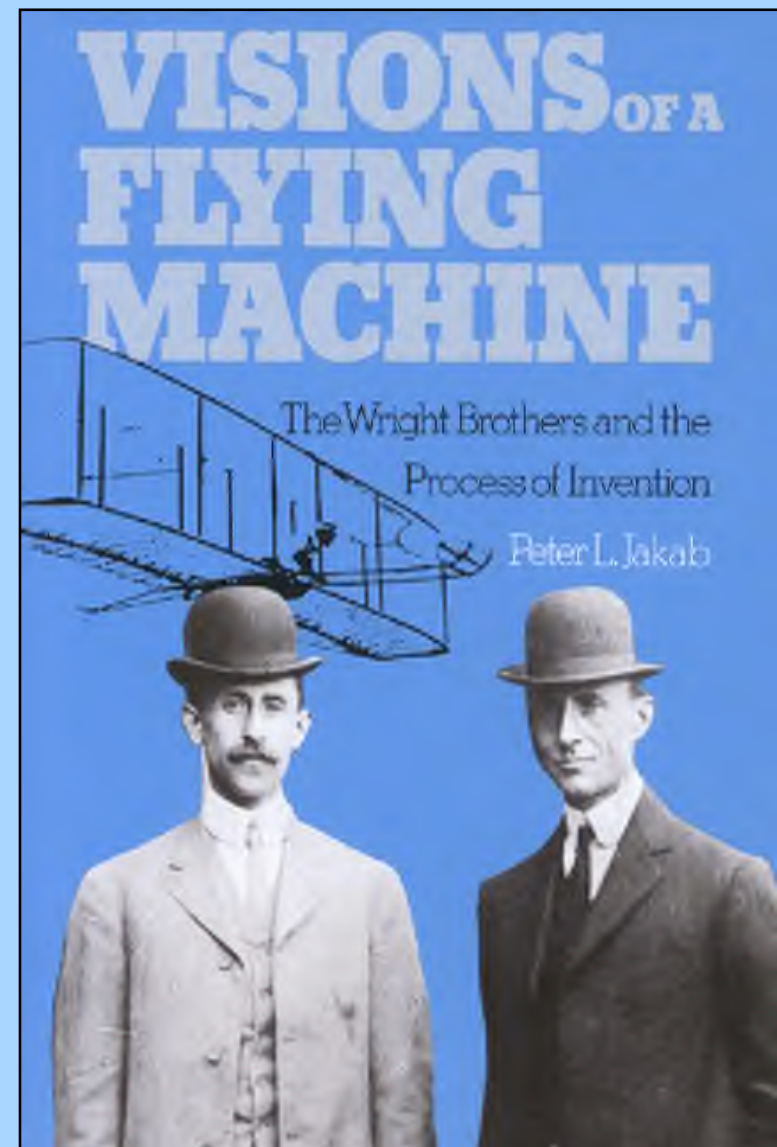
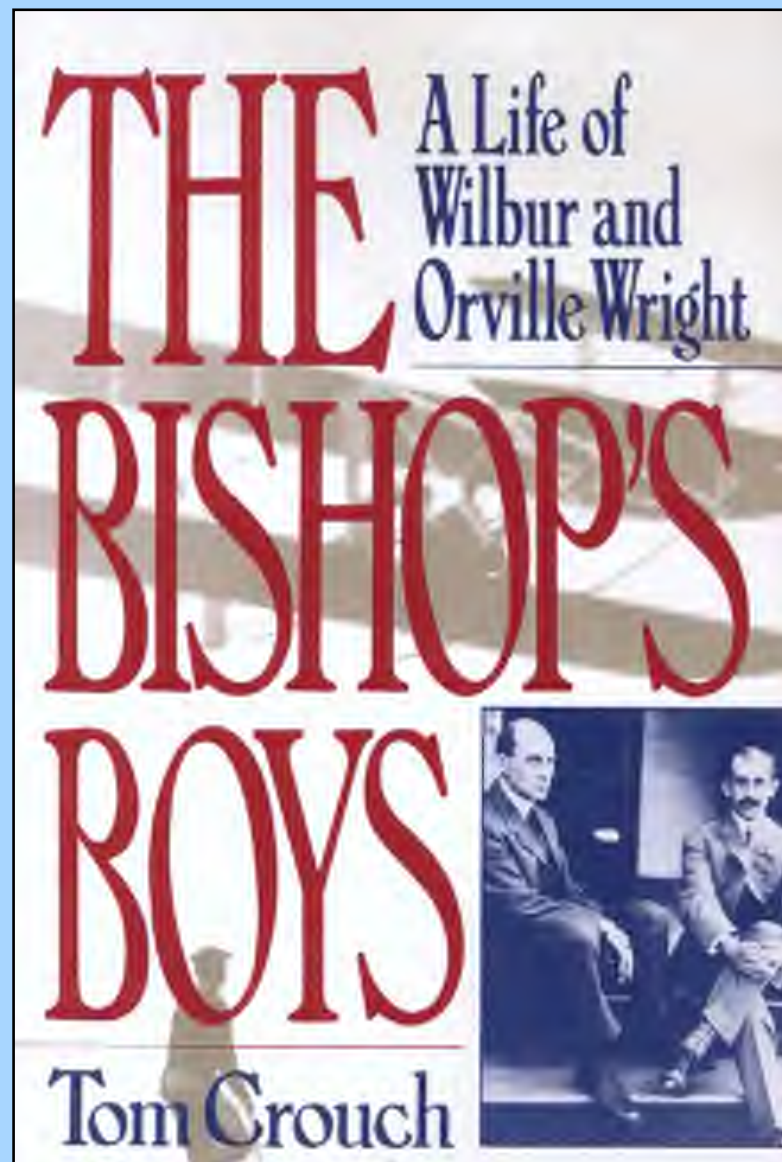


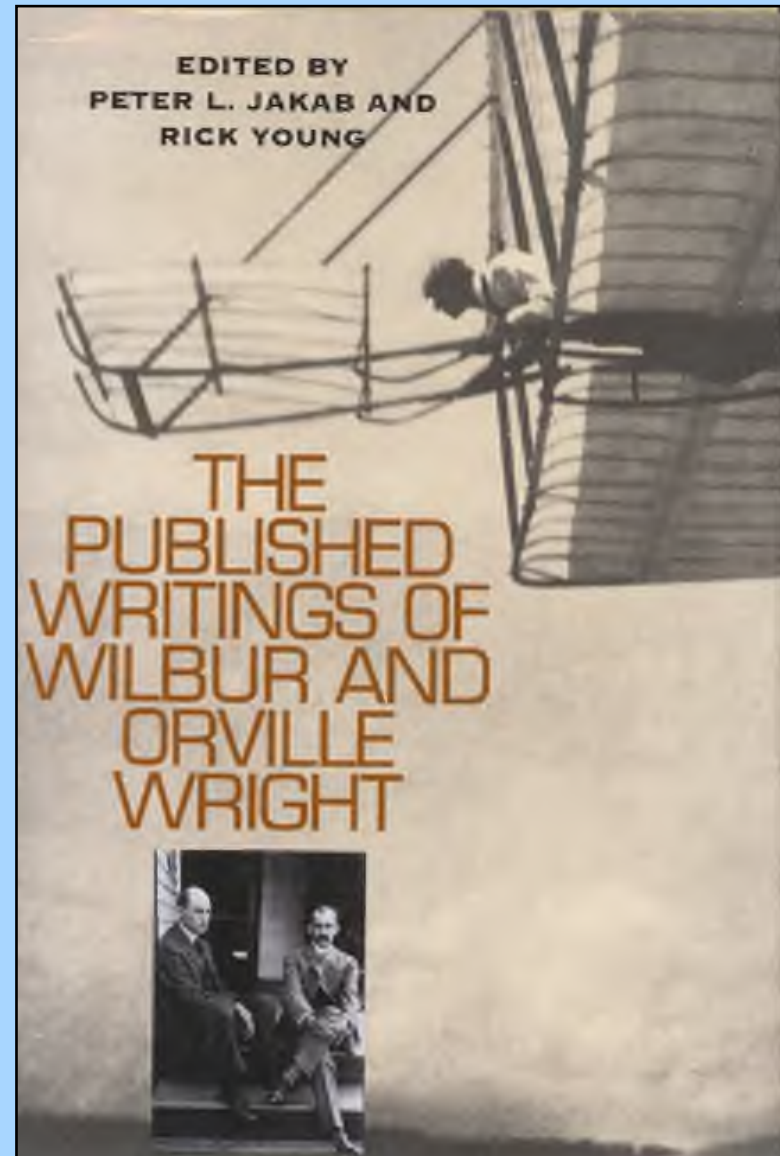
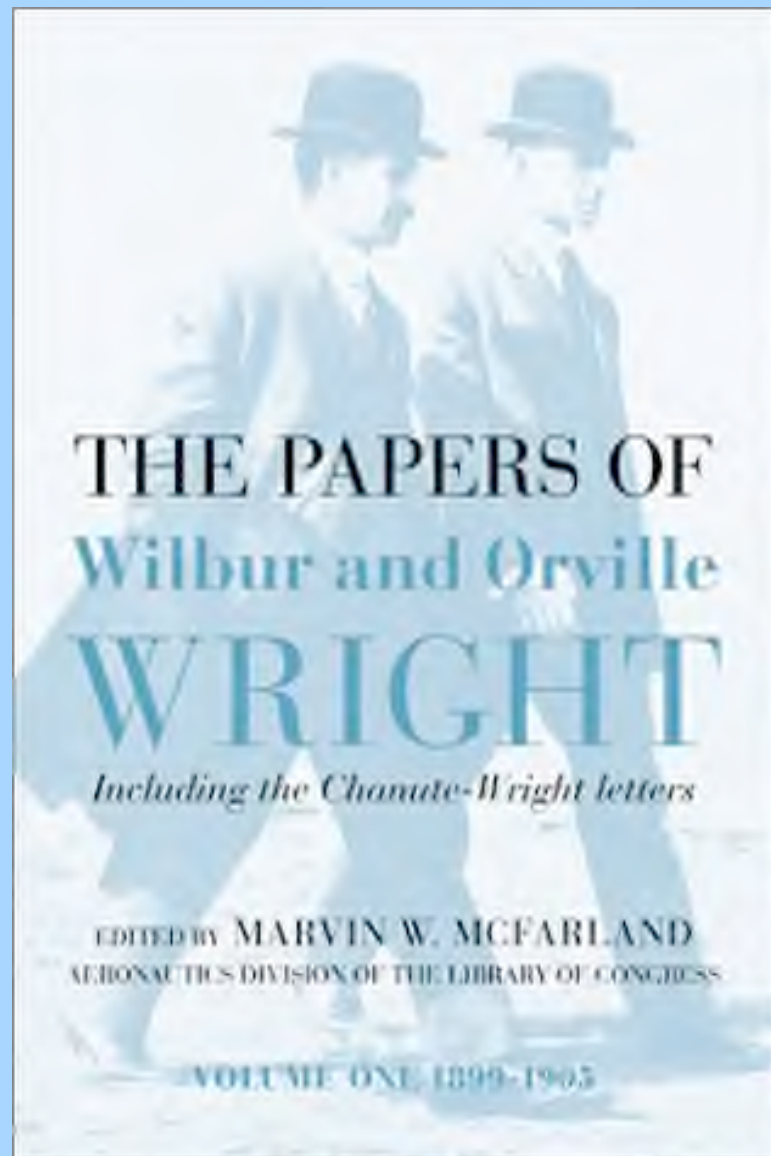
1903 Wright Flyer I
National Air & Space Museum

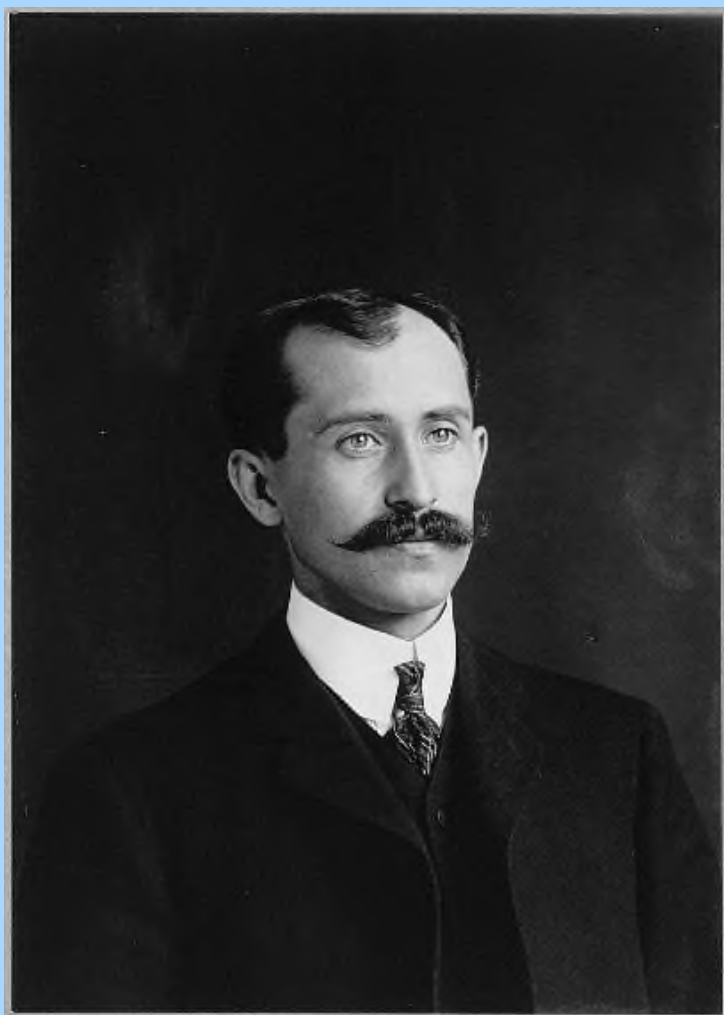


1905 Wright Flyer III
Carillon Hall









Orville Wright



Wilbur Wright

Orville's Camera: 1902 to 1905

